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# Developing Problem Based Learning Communities in Virtual Space

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## ABSTRACT

This paper examines the use of a Learning Management System (LMS) to develop learning communities for students undertaking a Problem Based Learning (PBL) university course. The PBL course is offered to both on-campus and off-campus (distance) students. Students use the LMS platform to undertake team based work, including team meetings, team communications, and electronic submission of team and individual assessments.

Statistics have been collected on students' usage of the LMS, both within a PBL team and by the student body as a whole. This data is analysed, in conjunction with feedback from students, to demonstrate how new communication technology is being used to create learning 'communities' in virtual space.

Distance students were able to form effective teams using only electronic communication methods. Despite never meeting face to face, it was found that distance students felt a great sense of 'community', which fostered mentoring and collaborative learning. The LMS provided an online learning environment that encouraged reflective thought and dialogue with others, both of which are critical to transformative learning and social constructivism. Interestingly, the LMS was also increasingly used by the on-campus students for virtual meetings in place of traditional face to face meetings.

This contemporary learning environment, made possible due to the creative use of new technology, compels the learner to become an active participant in the learning process. The focus is as much on the process as it is on the content; essentially the process of learning becomes part of the content that is learned. The process allows students to appreciate the value of participation, trust and mutual respect, and diversity, which are essential for effective functioning of teams in a global market place.

## INTRODUCTION

The University of Southern Queensland (USQ) is a regional university with its main campus located in Toowoomba, approximately 150 km inland from Brisbane. USQ achieved university status in 1991 after beginning in 1967 as a College of Advanced Education. It has developed an international reputation for distance and online education, with approximately 75% of its students studying in these modes.

The Faculty of Engineering and Surveying (FoES), one of five faculties at USQ, offers a number of undergraduate programs, Associate Degree (2 years), Bachelor of Technology (3 years), Bachelor of Surveying and Bachelor of Engineering (4 years), and numerous Double Degrees (5 years), as well as post graduate courses. These programs cover 9 majors: agricultural, civil, computing/software, environmental, electrical/electronic, mechanical, mechatronic, surveying (spatial science), and GIS. The faculty has no departmental divisions with many staff teaching in multidisciplinary teams, particularly in the junior levels of the programs.

ENG1101 Engineering Problem Solving 1 is a core course of all programs and majors. There is a diverse student intake and differing outcomes dependent upon major and program. Student teams are formed on the basis of a skills audit and are multidisciplinary. The staff team which facilitates student learning is also a multidisciplinary team with staff from all disciplines involved.

## PBL AT USQ

In 2000, FoES recognised the need to revise the curriculum to effectively integrate a number of graduate attributes required by professional accreditation bodies (Brodie & Porter, 2004). These attributes included teamwork (in multidisciplinary teams), communication skills (both written and oral), problem solving skills and life long learning skills (ABET, 2003; IEAust., 1999; IEEE, 2002). After 12 months of planning the first of 4 problem based learning (PBL) courses, ENG1101, was introduced. This course is now undertaken by all students of the faculty and therefore offers the opportunity for the teams to be truly multidisciplinary.

Whilst PBL has been effectively incorporated into a wide range of professional studies including medicine, nursing, dentistry, social work, architecture and engineering (Boud & Feletti, 1997) its application to distance education is not well documented. There are limited references to PBL in the distance mode and they mostly require some face to face interaction within the teams and with a facilitator (Brodie & Porter, 2004).

For the majority of students in FoES, physical meetings were not an option as the diverse student cohort is dispersed across Australia and the world. Students in ENG1101 have to work as a team across various time zones. In addition the majority of FoES students are employed in some professional capacity, and study by distance in a part time mode. Thus, student teams need to be able to integrate all the time constraints of the team members. The incorporation of a Learning Management System (LMS) along with sound pedagogical design was required to effectively enable students to learn not only the technical content of the course, but to do so in an environment which supports constructivism

and transformative learning. It has been demonstrated that a computer based learning environment can be used effectively in this situation (Reushle 2006; Wilson 2004) but this concept has not been extended in the literature to the fully online mode for PBL.

The LMS adopted by USQ was WebCT Vista 4.0. This platform allows discussion boards, chat and whiteboard facilities, electronic submissions of all assessment items - individual and team, announcements and links to external URLs. In the course ENG1101, students are allocated to a team of up to eight members. Up until 2006, each team has been a balanced mixture of two, three, and four year program students from different majors, as enrolments allow. In semester 1 2007 a skills audit of students prior to allocating to a team will be trialled. This will ensure there is a sufficient skill basis in the team for peer assistance and mentoring to take place (Gibbings & Brodie 2006; in press)

All teams are allocated a member of the teaching team to act as facilitator, and a team discussion board specifically for that team is set up. Teams have the ability to interact within their teams through the team discussion board, and with other teams through a 'combined' discussion board which allows interaction between on-campus and distance teams. There is also a default discussion board, accessible to all students for general queries. Confidential communication with the course examiner and team facilitator is also provided by a course email address.

Initially most of the facilitator interaction with the team is focussed on forming a suitable environment for the students to tackle the 'problems'. This is effectively helping the students form their own learning community, both on a team and course level.

## TEAMWORK AND COMMUNICATION

In Semester 1 2006 a total of 309 students enrolled in ENG1101, of whom 113 were in on-campus mode and 196 in distance mode. Students spent a total of almost 10,000 hours in 155,000 sessions on the LMS, and they posted a total of nearly 16,000 messages to the discussion boards. This communication accounted for 67.5% of student time (6,750 hours) spent on the LMS. The average number of postings on discussion boards was equally shared between on campus and distance students. This is an interesting result as it was assumed that on-campus students would make significantly less use of the 'virtual' communication methods, however these statistics indicate that on-campus students appreciate the flexibility offered by electronic communications and virtual teamwork.

Figure 1 indicates the majority of students believed that the LMS helped them manage the team's work over the semester. There was some resistance from on-campus students to using the LMS for team meetings and discussions. Feedback from on-campus students who strongly disagreed with the use of the LMS indicated that their main concern centred around a 'lack of training' in the use of the LMS. This is despite several training sessions being conducted during orientation by Information and Communication Technology (ICT) services, specifically for students, on the functions of the LMS. Steps have been taken for future offerings of ENG1101 to ensure on-campus students are more aware of these training sessions and to supply additional help resources for all students.

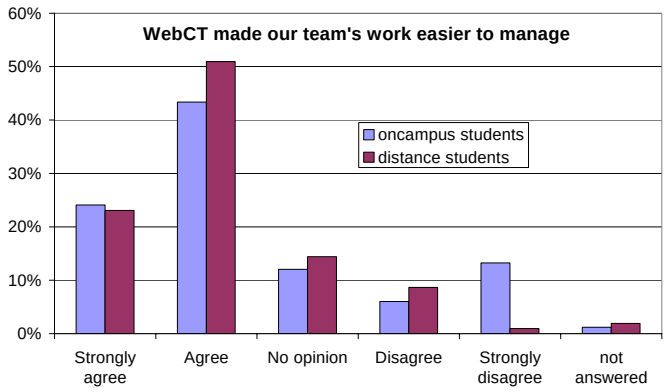


Fig 1 Student perceptions regarding the use of the LMS for teamwork.

Even though students from different time zones and geographic locations meet 'asynchronously', the authors believe that virtual team meetings for distance students are as effective as physical meetings for on-campus students and foster the desirable attributes of teamwork, conflict resolution and negotiation of tasks.

*'I also found that it was easy to communicate within a group via email and the Internet. I enjoyed this part of the course, as it allowed members to join in discussions at different times of the day and this suited the group as we all work different hours and have a range of internet access times available to us'* – (Student comment)

Figure 2 documents the average time per week, spent reading and posting discussions for on-campus and distance students. This graph accounts for 98.5% of the total time spent by all students on the LMS during the course of the semester. The remaining 1.5% was spent prior to semester starting and during the examination period after all assessments had been completed. The spike in time in week 2, particularly by the distance students, occurs as the majority of students begin their study. They have to spend considerable time reviewing the initial postings, which include facilitators giving hints and information to get started; initial questions from students and introductory messages from students. This large time allocation is daunting for distance students as they feel it is indicative of what they can expect for the duration of the course. This results in a significant number of distance students dropping the course either due to the workload of the course or computer problems. In future offerings a strategy to minimise this effect for distance students will have to be devised.

By week eight of the semester, on-campus students are utilising the flexibility offered by the LMS to conduct their teamwork. Their face to face meetings are minimised as is their face to face contact with their facilitator. Facilitators usually continue to meet with day teams in regular face to

face meetings for as long as the teams require, and at the discretion of the team.

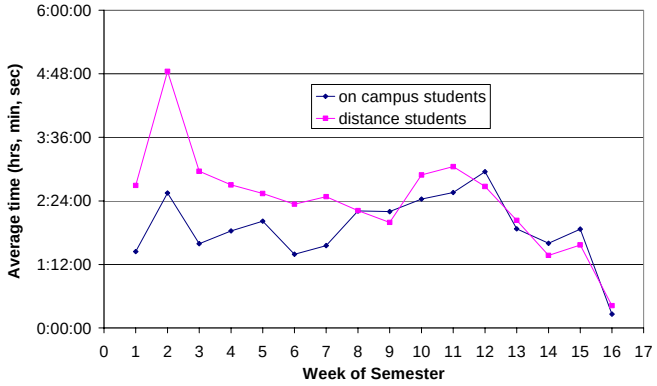


Fig. 2 Average Time per Student per Week of Semester

## LEARNING COMMUNITY

For distance students, working in a student team is a novel experience. For most, ENG1101 provides their first opportunity to actively work with other students. This social interaction has particularly benefited the distance student in their transition to university study. Figure 3 indicates that the course was successful in introducing students to a social network which they could use outside this course and 'break the ice' in the university setting.

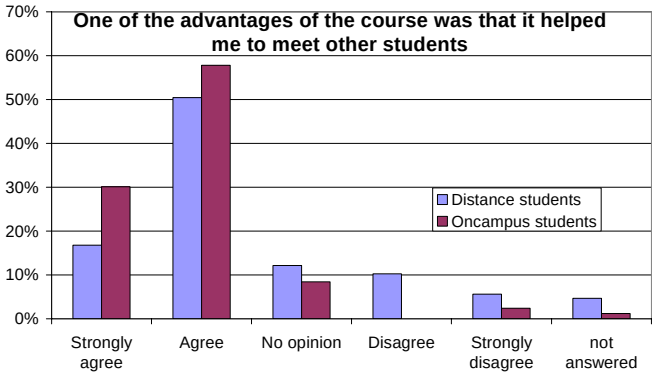


Fig. 3 Advantages offered by the LMS for social networking

The on campus students also benefited from this initially forced group interaction. Anecdotal evidence suggests that some teams or members of teams request to work together in the following course. They may try to rid themselves of the 'social loafer' but the core of the team often wishes to remain together.

*'I enjoyed working with most members of my team and it was good to be able to talk to other students in the same position as me, I was also able to get help with other subjects from some of my team members'* – (Student comment)

*'… we all have a lot of fun together even though we have never met face to face. Our team has found common interests and all show a genuine concern for each others welfare'.* – (Student comment)

These quotes highlight the social aspect of learning in the PBL course, the importance of which has been well documented in the literature with respect to human learning in general (for example Brown & Duguid 2000; Dewey 1938; Kilpatrick, Barrett & Jones 2003; Salmon 1993; Smith 2003). In contrast to Brown and Duguid (2000), evidence from ENG1101 indicates that this social aspect to student learning is occurring in the online environment and it is being improved by the judicious use of the communication features of the LMS. This ability of the internet, provided it is used appropriately, to significantly improve the learning experience in virtual space is a view supported by Tu and Corry (2002), and Reushle (2005, p. 10; 2006, p. 7).

## INDIVIDUAL LEARNING GOALS AND MENTORING

As part of the first individual assessment item for students they must identify several personal learning goals. They are required to compare their particular skill and knowledge set, based on their prior knowledge and experiences, to those required by the course specification and then identify both technical knowledge and teamwork goals. These goals can include acquiring basic knowledge or skills or the extending of existing skills/knowledge. Feedback is provided by facilitators to ensure the goals are adequate and consistent with the requirements of the course.

Once individual learning goals have been identified students are encouraged to share current skills and knowledge and their learning goals with team members. From this basis, students plan peer assistance or mentoring opportunities within the team. From 2007 this will be further enhanced by an initial formal skills audit of the students and then forming teams based on these results to ensure an adequate skills base for mentoring to occur (Gibbings & Brodie, 2006).

Mentoring within the team has resulted in students learning from each other and valuing the diversity of the team. As recognised by Brown and Duguid (2000, p. 143), this has allowed teams to produce more creative solutions than would be possible from an individual. The sense of community within the teams has led to true collaboration since it involves the sharing of creation, understanding and discovery (Schrage 1990, p. 6).

*'One of my team mates had suggested that he would like to learn more about PowerPoint, so we have been paired for this task. As I am quite comfortable with the use of PowerPoint, I developed a simple training package for my team mate to show him the basic tools that you can use with this software. We have also collaborated via MSN Messenger on the content of the presentation. I have enjoyed the opportunity to help a team mate learn a new skill'* – (Student comment)

*'Diversity works for the team because we: Solve a problem using different viewpoints; Use each others' skills to increase the team's output; Learn skills from one another'* – (Student comment)

*'One good thing about the course is that I can see how the other students tackle these things and learn from them.'* – (Student comment)

*'With so much interaction between other students in this course, it is hard not to learn a great deal. Each person has a large amount of useful information and with this combined*

*into a team environment; this collective information can almost seem endless.'* – (Student comment)

Figure 4 shows that 85% of distance students and 80% of on-campus students felt that the course had significantly improved their appreciation of the prior knowledge and skills of their colleagues and how these skills can be used to advantage in their own learning and in problem solving.

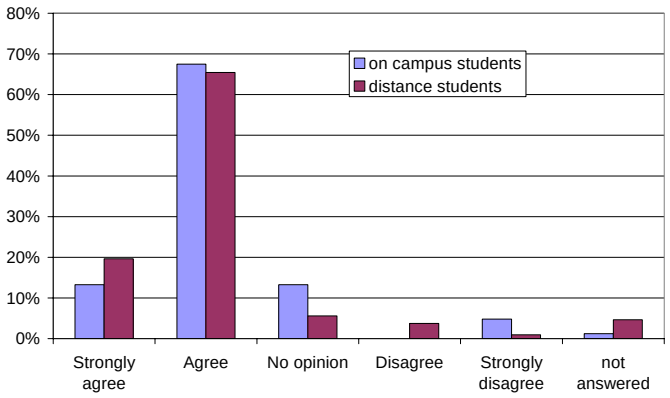


Fig. 4 Appreciation of the prior knowledge and skills of peers

## CONCLUSIONS

PBL in engineering education is attracting wide spread interest from academics who believe it can deliver many of the required attributes such as teamwork, problem solving and communication skills as well as discipline specific technical content as applied to solving realistic problems. However emerging requirements of graduates now include attributes such as working globally in a multicultural environment; sharing of work tasks on a global and around the clock basis and working in a virtual environment (National Academy of Engineering 2004; Thoben & Schwesig 2002). PBL and engineering education in general must respond to these demands. At the same time the pedagogy and course design must adequately cover the formation of a community to support student learning. In the rush by academics to take up new technologies and online education this 'learning community' has often been forgotten. The process of forming and working in functional teams in virtual space is one of the main objectives of ENG1101 and results demonstrate that this is being achieved. This is evidence that the focus on a common interest by all members in the teams can indeed 'transcend geography' (Kilpatrick, Barrett & Jones 2003, p. 3).

*'I work in the construction industry and team work is essential. The biggest problem we have with the [qualified] consulting engineers is their inability to communicate with each other, especially at a distance. We have to get them to site and face to face to work through design issues. I believe you should do at least one project [at university] where all the teams work remotely from the other team members.'* – (Student comment)

*'One thing I did learn from this course is that team-based problem solving is a much more enjoyable method of learning and I also believe that I learned a great deal more than usual'* – (Student comment)

There is evidence that students in ENG1101 are learning through jointly 'constructing' knowledge through dialogue on the LMS with other students and facilitators. This is in line with the adult learning concept of transformative learning, the essence of which is grounded in constructivism. Students have ample opportunity to critically reflect and to validate new ideas to interpret these learning experiences in their own contexts, all of which is important for adult learning. The virtual e-leaning atmosphere created through the use of the LMS in ENG1101 for distance students has been shown to offer an environment conducive to this type of learning.

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